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QUARTERLY RESEARCH REPORT JANUARY 1-MARCH 31, 1972

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Environmental Protection Agency
ALASKA WATER LABORATORY

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QUARTERLY RESEARCH REPORT

January 1 - March 31, 1972

ALASKA WATER LABORATORY

Fairbanks, Alaska 99701

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JANUARY 1 - MARCH 31, 1972

ALASKA VILLAGE DEMONSTRATION PROJECT

PROJECT: 16100 ZNM

Objectives:

To plan and construct, in one or more Alaskan villages, projects to provide a central safe water supply and waste disposal facility in conjunction with community laundry and bathing facilities and a community health education program to help assure continued beneficial use of the projects.

Work Accomplished Third Quarter FY 1972:

At a series of meetings in January, agreements were reached regarding scope of work to be performed, cost ceilings, and construction schedules. By February 17, the contract office was able to issue letters authorizing contractors to proceed with work. The formal contract documents will be finalized in early April.

At this point, designs are completed and subcontractors are beginning module fabrication.

Arrangements have been made for operator trainees to return to Fairbanks for review of instructions provided in August 1971, and a briefing on final design in preparation for a factory visit where they will participate in all phases of construction and equipment installation.

At Wainwright, the building site has been surveyed, and holes for the piling foundation have been drilled.

Much effort has been expended in determining the most economical and advantageous method of shipping modules, tanks, and fuel to the project sites. Decisions in this regard are still pending.

A paper which summarizes the results of investigations of social and economic conditions in the project villages has been prepared. The study speculates on the social impact of the demonstration facilities and makes policy recommendations in regard to operation and maintenance financing.

In recognition of the need for continuity in support available to small rural water and waste disposal utility systems, a bill drafted by the Alaska Department of Environmental Conservation was recently submitted to the State Legislature. This Bill (BH-719) would enable the State government to provide operation and maintenance assistance to rural communities with facilities of the type constructed under the EPA demonstration project. Such provisions are considered essential to the long term success of the Alaska Village Demonstration Project.

COLD CLIMATE RESEARCH

PROJECT 16100 ZNB - COLD REGIONS EXTENDED AERATION DESIGN CRITERIA

Objectives:

To develop empirical cold regions extended aeration design criteria from the operation of two adjacent parallel exposed units (aeration tanks). One unit has an enclosed conventional (horizontal flow) clarifier; the other, an enclosed upflow clarifier with tubes. Both units are located at the Eielson Air Force Base, 22 miles southeast of Fairbanks.

Work Completed Third Quarter FY 1972:

Addition of a spray system to the cooling pond allowed the feed temperature to drop from 20+°C (heated utilidors) to 7°C or less.

The January and February (~1/2 day detention) data are summarized as follows:

Clarifier	Mixed Liquor T°C	Loading BOD/MLSS-day	Average %BOD Removal
Hz	7-12	0.12	74
Hz	2-7	0.17	9
Up	7-12	0.14	80
Up	2-7	0.41	<0

Freezing problems with the sludge return system may have accounted for the poor performance of the upflow clarifier section in the 2-7°C range.

From the data it appears that the loading effect upon performance is much more pronounced at lower temperatures.

Performance data from the EAFB units and from a nearby oxidation ditch was summarized and presented at an Alaska Technology Transfer Design Seminar on March 28, 29.

Work Plan Fourth Quarter FY 1972:

Collect low loading (~0.07 BOD/MLSS-day) data in the 0-5°C range, and incorporate all the EAFB information into the working paper on Design Criteria for Low Temperature Extended Aeration.

PROJECT 16100 ZNE - COLD REGIONS AERATED LAGOON DESIGN CRITERIA

Objectives:

To establish design criteria for the aerated lagoon waste treatment process in Alaska, and to evaluate parameters and contribution to effluent quality, power and maintenance costs, and reliability.

To establish the feasibility of using open type (non-clogging) diffusers in an aerated lagoon and obtain design information.

To determine the comparative effects of open type diffusers and perforated tubing diffusers on aerated lagoon process efficiencies.

Work Completed Third Quarter FY 1972:

Monitoring of the pilot aerated lagoon at EAFB and the Ft. Greely aerated lagoon continued through the quarter.

Dissolved oxygen uptake and oxygen transfer efficiency tests are being performed at the Ft. Greely lagoon.

Work Plan Fourth Quarter FY 1972:

At Eielson AFB - Continue monitoring the pilot lagoon.

At Ft. Greely:

1. Continue sampling on a biweekly basis.
2. Continue oxygen transfer efficiency tests.

PROJECT 16100 ZRD - COLD REGIONS SLUDGE DIGESTION AND DEWATERING

Objectives:

To demonstrate the feasibility of using shallow lagoons and the cold environment as a means of concentrating and dewatering waste activated sludges and to gather enough information from the process to determine practicality.

Work Completed Third Quarter FY 1972:

Last fall an aeration device was installed to circulate the mixed liquor so the suspended solids could be captured in the growing surface ice. The aeration device plugged during the last quarter.

Analysis of core samples indicate less than 12,000 ppm SS in the richest ice layer. Based on a wasted MLSS concentration of 3,000 ppm a concentration factor of less than 4:1 was obtained.

Aerator plugging and lack of sufficient waste MLSS (from the extended aeration pilot units) prevents complete evaluation of this process as a means for sludge digestion, concentration and dewatering.

Work Plan Fourth Quarter FY 1972:

Due to problems mentioned above this project will receive low priority.

PROJECT 16100 ZNH - SIGNIFICANCE OF BOD AS AN ALASKA WATER QUALITY PARAMETER

Objective:

To define the effects of arctic and subarctic conditions on the BOD progression by investigating the combined effects of temperature, turbulence and river water dilution on BOD reaction rates and the BOD test.

Work Completed Third Quarter FY 1972:

DO uptakes have been found to be greater in the large containers utilized in the experiment than in BOD bottles normally used. Because of surface area to volume considerations, these results are opposite of what would normally be expected. The heads for the large containers are of plexiglass and may be contributing to the higher growth rates. Experiments have been initiated to determine the cause of this phenomenon.

Work Plan Fourth Quarter FY 1972:

Continue the experiments to define the cause of greater DO uptakes in the large containers.

PROJECT 16100 ZOD - LOW TEMPERATURE DISINFECTION

Objectives:

To develop laboratory and field technics for studying effectiveness of disinfectants.

To determine the effectiveness of chlorine disinfection at low temperatures on primary and secondary sewage treatment plant effluents.

Work Completed Third Quarter FY 1972:

The effluents from two secondary waste treatment plants and one primary plant were examined in batch systems for the effectiveness of chlorine as a disinfectant at 0°C. Several tentative conclusions can be drawn from these studies:

1. Chlorine is nearly as effective as a disinfectant at 0°C as it is at 25°C.

2. Chlorine demand is related to the suspended solids concentration as would be expected.

3. Some secondary effluents are more difficult to disinfect than a primary effluent.

4. Coliform kill is not related directly to any of the standard chemical analyses used in examining effluents.

5. The chlorine residual necessary to attain disinfection varies widely with different effluents.

6. Fecal coliforms are much more susceptable to chlorine than are total coliforms.

Work Plan Fourth Quarter FY 1972:

A third type of secondary treatment plant effluent will be examined for the effectiveness of chlorine as a disinfectant at 0°C. The data will be subjected to complete analysis and a report will be prepared.

PROJECT 16100 ZND - LOW TEMPERATURE MICROBIOLOGICAL ACTIVITY AND DO DEPLETION

Objectives:

1. Complete the rate study of the stationary vs. dynamic closed system and effect of velocity of the water on rate of DO depletion at 0° and 5°C.

2. Survey gross nutritional requirements of selected pure cultures of indigenous river bacteria which are capable of rapid DO depletion at 0° and 5°C with protein as the nutrient.

3. Determine the effect of nutrients required for the pure cultures on the rate of DO depletion by the natural mixed population of bacteria in unpolluted river water.

Work Completed Third Quarter FY 1972:

Microtechnics have been examined for use in the carbohydrate fermentation portion of the pure culture nutrition studies and were found wanting in that they did not provide sufficiently definitive results. Three acid/base indicators covering different pH ranges were used in a limited examination of carbohydrate fermentation. This limited examination indicated that carbohydrate fermenting ability varies greatly in these cultures.

The monthly enumeration of the indigenous bacteria in unpolluted river water is continuing at 0°, 20° and 35°C. The low count at 35°C has remained fairly constant, and the 0° and 20°C counts have started increasing after reaching their lows in late January to early February.

Work Plan Fourth Quarter FY 1972:

The nutritional studies and the monthly counts will continue.

PROJECT 16100 XCN - WINTER D.O. CONDITIONS IN ALASKAN WATERS

Objectives:

1. Examine the effects of low dissolved oxygen concentration on aquatic organisms.

2. Examine some of the causes of winter low dissolved oxygen phenomenon that has been documented in Alaskan streams.

3. Continue on a limited time and money available basis the survey of winter DO conditions in Alaskan waters. More emphasis will be placed on lakes and pond waters.

Work Completed Third Quarter FY 1972:

Informal review of the Winter DO in Alaskan Rivers and Streams has been completed. Manuscript redraft, with corrections, table and figure editing has been started.

Dissolved oxygen, conductivity, alkalinity and pH data are tabulated for several Alaskan lotic systems.

The design of the degassifier that is amenable to the physical facility has been completed. Cost to build this system inhouse has been estimated. Comparison of these costs to the costs of commercial packages resulted in the conclusion that it would be better from a time expenditure point of view to purchase a commercially produced complete system. At this point, further progress has been retarded pending arrival of additional cost estimates from commercial enterprises.

Data was collected from five winter field stations. Further field investigation revealed another utilizable sample site essentially downstream from the effluent discharges of Fairbanks. Presently, biological and physical-chemical sampling is on schedule at one set per month. Preliminary analysis of quantitative and qualitative biological samples continued although no data have been tabulated.

Results of the validation of the cold weather DO sampling technique have been placed in manuscript form. Copies of the draft were distributed for first informal review and then formal review. Both processes have been completed, and the manuscript is now being printed.

Work Plan Fourth Quarter FY 1972:

Winter DO manuscript editing will continue for formal review. Tables and figures will be modified by the addition of data. Final corrections will be made prior to publication.

Purchase of the degassifier system is planned. Assembly of the system will begin pending the arrival of the complete package.

Winter field sampling will continue at the same level of one set per month. More intensive sampling, beginning with the approach of spring breakup and advent of summer, includes physical-chemical parameters over a 24 hour interval and collecting biological and physical-chemical samples every week.

PROJECT 16100 ZOB - MANAGEMENT OF GRAVEL REMOVAL PRACTICES ON THE NORTH SLOPE TO ENHANCE WATER QUALITY

Objectives:

The overall objective is to ascertain the effects of stream bed disturbance on stream hydraulics and sediment loads, how these sediments influence water quality and short and long-range effects of sediments on aquatic life.

Objectives for FY 1972 include becoming familiar with methods to accomplish the study, select reaches of representative streams likely to be disturbed and collect and analyze samples of water, gravels, and invertebrate fauna of several streams.

Work Completed Third Quarter FY 1972:

Work on the logging road guide described in the last Quarterly Report is progressing and an early draft is about 50 percent complete. Inputs and suggestions were received from the State forester in Fairbanks and research hydrologist, U.S. Forest Service, College. A small logging operation on the Chena River was visited and photographs of the operation obtained.

Working Paper No. 14, describing observations made at the Wickersham Dome fire, was received from the printer and is available at the office of the Director, AWL.

Work Plan Fourth Quarter FY 1972:

Make the proposed trip to Corvallis and complete a work plan based on suggestions received during these discussions.

PROJECT 16100 ZQL - ECOLOGY OF TUNDRA LAKES

Objectives:

The Tundra Lakes project is part of the International Biological Program. This comprehensive program is intended to study various biomes to better understand and manage the areas. The IPB Tundra Biome intensive study site, located at Point Barrow, has three terrestrial subprograms and one aquatic subprogram. In the aquatic subprogram these studies include: physical-chemical characteristics of ponds; microbiological metabolism in sediment; zooplankton population dynamics.

Work Completed Third Quarter FY 1972:

Project virtually inactive this quarter.

Work Plan Fourth Quarter FY 1972:

Work will be limited. One field trip may be scheduled this quarter depending upon the timing of hydrologic events. This trip will be coordinated with existing IBP projects.

PROJECT 16100 ZOY - BASELINE STUDY OF A NATURAL SUBARCTIC WATERSHED

Objectives:

The overall objective is to obtain sufficient data on all aspects of the aquatic ecosystems in the Poker-Caribou Creek watershed over a long enough time interval to enable development of a watershed model as a reliable tool to predict dynamic behavior of subarctic watersheds when defined perturbations are imposed on them.

Work Completed Third Quarter FY 1972:

A conference was held at the Institute of Northern Forestry late in March to coordinate broad plans and objectives of this project. Representatives of AWL, USACRREL, and U.S. Forest Service were present and it was decided to draft a memorandum of understanding to be sent to and signed by all agencies that will actively participate in the project. A master plan is being drafted by CRREL to give broad guidance to future coordinated planning of individual projects of participating agencies.

Further exploration of the preparation of a detailed geologic map of these watersheds resulted in the opinion that it is a much larger undertaking than earlier proposed by U of A geologists. Field work would require considerable drilling because few bedrock outcrops are available. Plans for the larger topographic map are progressing and such a map should be available sometime in the fourth quarter.

Work Plan Fourth Quarter FY 1972:

Complete the large topographic map, make one sampling run after breakup, and complete a work plan for FY 1973 with suitable revisions as dictated by budgets for FY 1973.

PROJECT 16050 XCU - FATE AND EFFECT OF OIL SPILLS ON ALASKAN STREAMS

Objectives:

1. To characterize the nature and extent of oil as it is transported over and through organic (soils and vegetation) and inorganic layers after being applied to an Interior Alaskan watershed.

2. To demonstrate the influence of such things as runoff water and permafrost on transport of oil.

3. To determine changes in character of crude oil spilled on cold streams (0-5°C).

Work Completed Third Quarter FY 1972:

Although some work in the laboratory has been done dealing with oil extraction from soils, changes in work plans and delays in obtaining equipment have obstructed progress on this project. The original and

primary objective of the project was to be an investigation of a controlled oil spill on the Glenn Creek watershed. The spill was to be conducted by the U.S. Army Cold Regions Research and Engineering Laboratory (USACRREL), but due to a lack of funding, they have abandoned the Glenn Creek project for the present, thus forcing AWL to pursue another course in oil pollution investigations.

Equipment for model stream studies has only recently been gathered and still awaits some shop work before being put into operation.

Work Plan Fourth Quarter FY 1972:

Since USACRREL will not be conducting the oil spill on the Glenn Creek watershed, new goals will have to be set for this project. Possible alternatives include monitoring an accidental spill or having AWL set up its own controlled spill, but no decision has yet been made. Meanwhile, the model stream studies will be initiated.

CONSOLIDATED LABORATORY SERVICES

CLS performed approximately 2500 requested chemical analyses during the quarter, in addition to providing a major effort in identification of bottom fauna organisms.

New methods are being developed for arsenic and boron in waters and wastewaters. The arsenic method is developed around the generation of arsine gas, which is then introduced into a hydrogen-argon flame in the Atomic-Absorption Spectrophotometer. Boron is determined by a colorimetric procedure using azomethane H.

March 14 we began receiving weekly samples from the USAF lagoon at Elmendorf for analysis of phytoplankton pigments by the Fluorometer method. It is hoped that these data will give us an indication of the timing and amount of phytoplankton blooming in these systems.

Additional repairs to the building drain system, destroyed by acid drainage over a period of years, were made this quarter. This problem is also causing destruction of at least one of the laboratory sinks, which we will try to replace this summer.

GRANTS AND CONTRACTS

PROJECT 16100 EOM - "Baseline Water Quality Study of the Alaskan Arctic Estuarine Development," Institute of Marine Sciences, University of Alaska, Dr. Patrick J. Kinney.

Analysis is continuing on the samples collected during the field season. Some facets of the study are continuing data collection during the winter. A draft copy describing the results of the analysis performed to this quarter was presented to the project officer. A project proposal for the third grant period has been transmitted to Grants Administration.

PROJECT 16100 FWQ - "Investigations on Possible Effects of Crude Oil on Aquatic Organisms of the Central Alaskan Fisheries," Department of Biological Sciences, University of Alaska, Dr. James E. Morrow.

The grant period expired at the end of November, 1971. Although this grant is to be continued, new funding has not been made available. During the interim, preparation of tissue sections for examination is continuing.

PROJECT 16100 PAK - "Lime Disinfection of Sewage Bacteria at Low Temperature," Department of Microbiology, Colorado State University, Dr. S. M. Morrison.

The effect of high pH values on the death of fecal bacteria in raw sewage has been completed at 10°C. The effect of lime on BOD and o-phosphate removal in raw sewage is being examined at low temperature. The effect of high pH values on the death of fecal bacteria in secondary effluents is being studied.

PUBLICATIONS AND PRESENTATIONS

Two papers in the "Working Paper Series" were published this quarter. They were:

#14 - "Effects of Wickersham Dome Fire on Water Quality of Washington Creek," February 1972

#15 - "Laboratory Evaluation of an Improved Sampling Procedure for for Dissolved Oxygen," March 1972

The following discussions were held by Alaska Water Laboratory employees at the Technology Transfer Design Seminar, held in Anchorage on March 28, 1972:

"Special Consideration for Disinfection of Cold Effluent," Ronald C. Gordon

"Alaska's Unique Receiving Waters," Ernst W. Mueller

"Designing Extended Aeration Units for Operation in Cold Regions," Harold J. Coutts.